Present Status and Plan of Research and Development on HTTR and Hydrogen Production in JAERI

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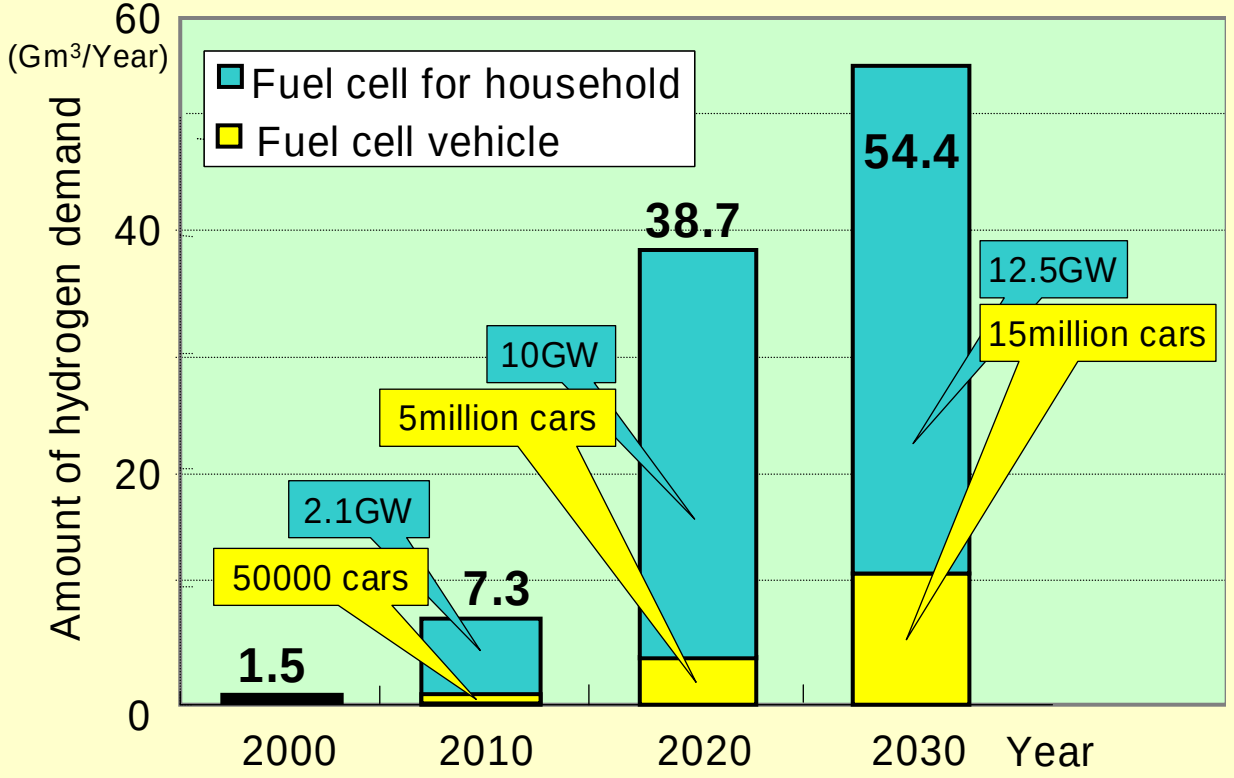
Nuclear Production of Hydrogen

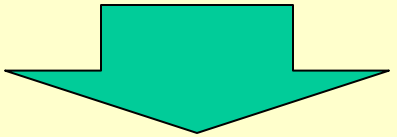
Nuclear production of hydrogen could meet massive demand in the future!

- Target for introduction of fuel cell vehicles (FCVs) to market in Japan

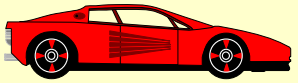


One HTGR

with thermal power of 600MW



One million FCVs



(75 million cars in JAPAN)

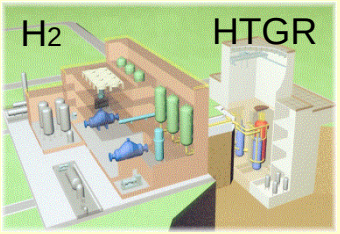
(Source: WE-NET Report & MEXT home page)

Supply Power of Hydrogen to H_2-Station

Facility for energy conversion	Site area necessary to produce hydrogen of 300m^3/h at one small H_2-station of 0.1ha (=40m x 25m)
Photovoltaic cells	6-10 ha 60-100 times area of H_2-station
Windmills Two large windmills (75-88 m blade-diameter)	30 ha 300 times area of H_2-station
HTGR Thermal output of 600MW	6 ha for about ***270*** H_2-stations

H2-station

Height; 100 m



(M. Ogawa and S. Shiozawa, GENES4/ANP2003, Sep. 15-19, 2003, Kyoto, JAPAN, Paper 1055)

High Temperature Gas-cooled Reactors

$H_2O \rightarrow H_2 + ½\ O_2$

Theoretical Efficiency of Water Splitting

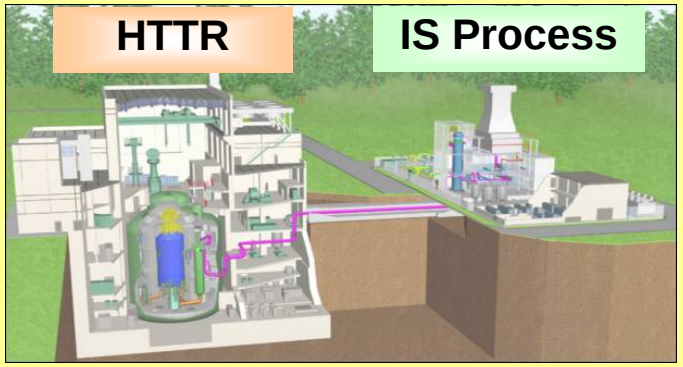
$$\eta = \frac{\Delta H_{H_2}}{\Delta H} = \frac{T_H - T_L}{T_H} \frac{T_d}{T_d - T_L} \qquad (T<T_d)$$

(Δ H:Input energy, Δ H_{H_2}:Hydrogen energy, T_H:Temp. of heat source, T_L:Temp. of heat absorber, T_d: =4309 K, Temp. at ΔG=0 in water decomposition, G:Free energy)

Higher temperature is higher theoretical efficiency !

HTGRs can produce hydrogen with high efficiency !

Present Status of HTTR Project



Hydrogen Production Technology

System Integration	IS Process
● Safety evaluation, Isolation valve test; → On going	● Bench-scale; June 2004 ● Pilot-scale ; from 2005 ● HTTR IS ; from 2010

Reactor Technology

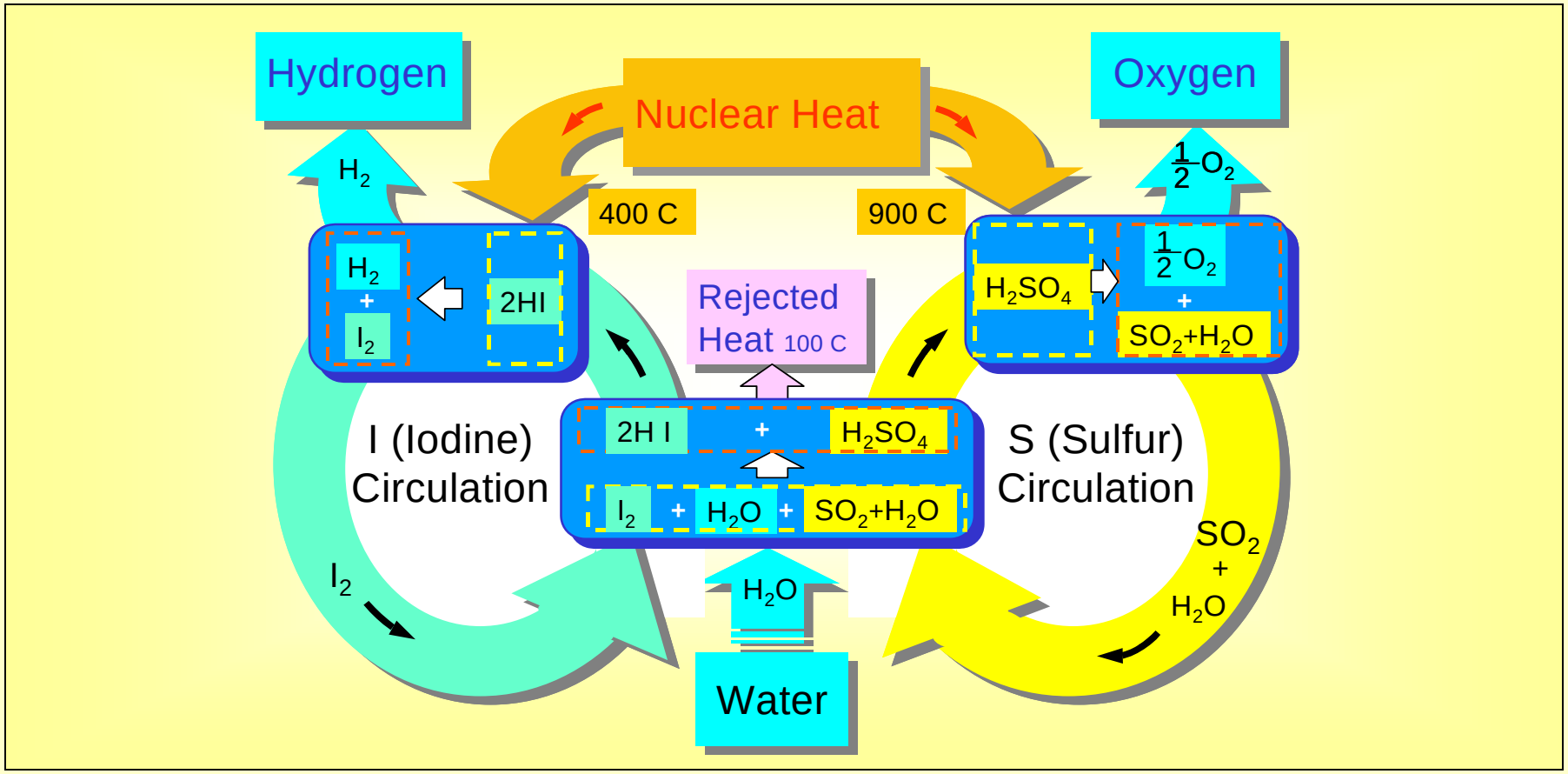
- Achievement of 950℃ (30MW) ; Apr. 2004
- Safety Demonstration Test ; On going
- High Performance Test of Fuel and Materials ; On going

Design, and Gas Turbine Technology

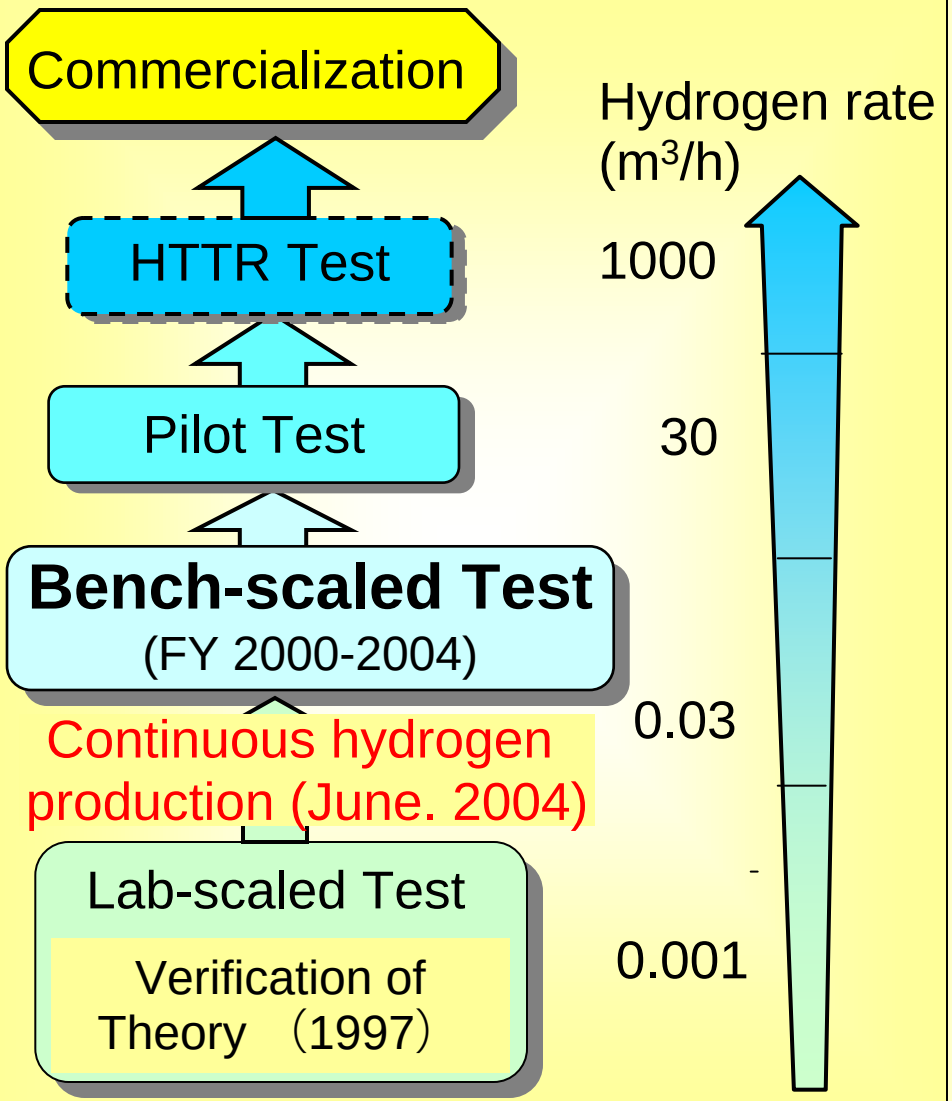
- Design of GTHTR300 (Electricity, 850℃) and VHTR-GTH2 (Electricity and hydrogen, 950℃) ; On going
- Tests of Compressor, Magnetic Bearing and Control ; On going

Thermochemical IS Process

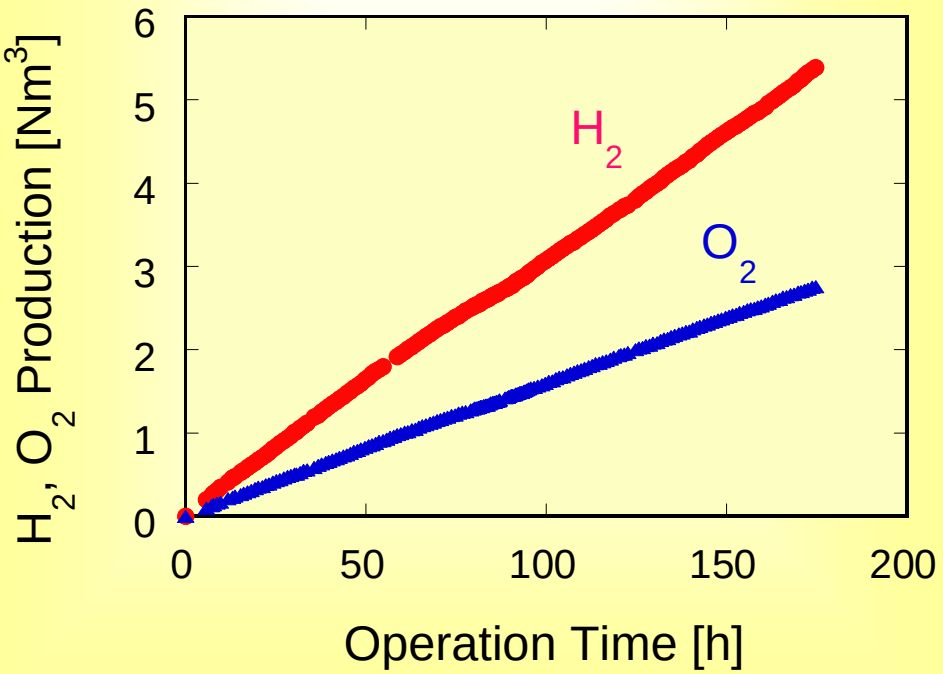
- Pyrolysis of water; Heat more than 4000℃
- IS Process ; One of thermochemical methods using heat less than 900℃ with I (Iodine) and S (sulfur)



Result and Plan of IS Process (JAERI's Proposal)

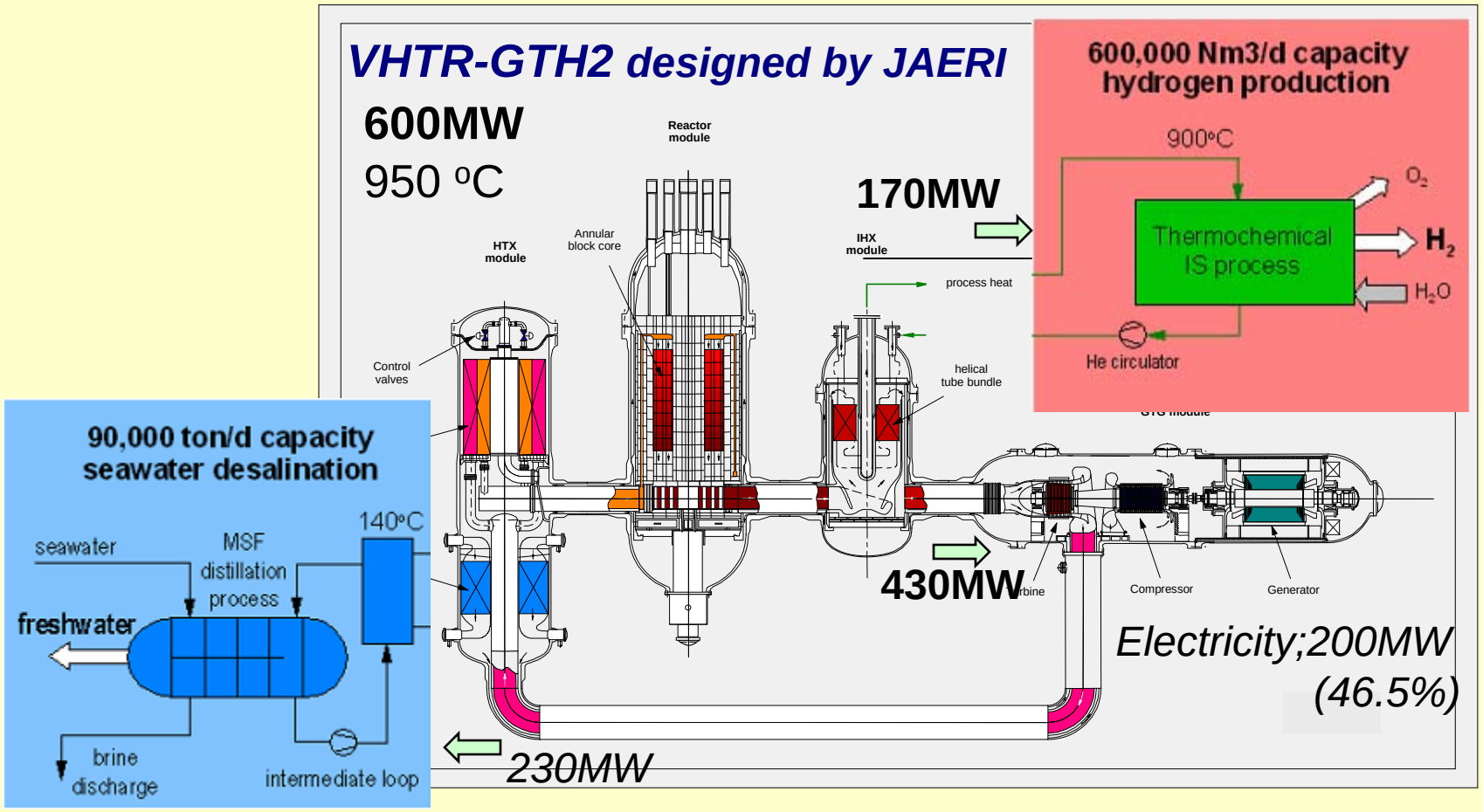


Continuous hydrogen production was successfully achieved with hydrogen production rate of about 30NL/h for 1week.

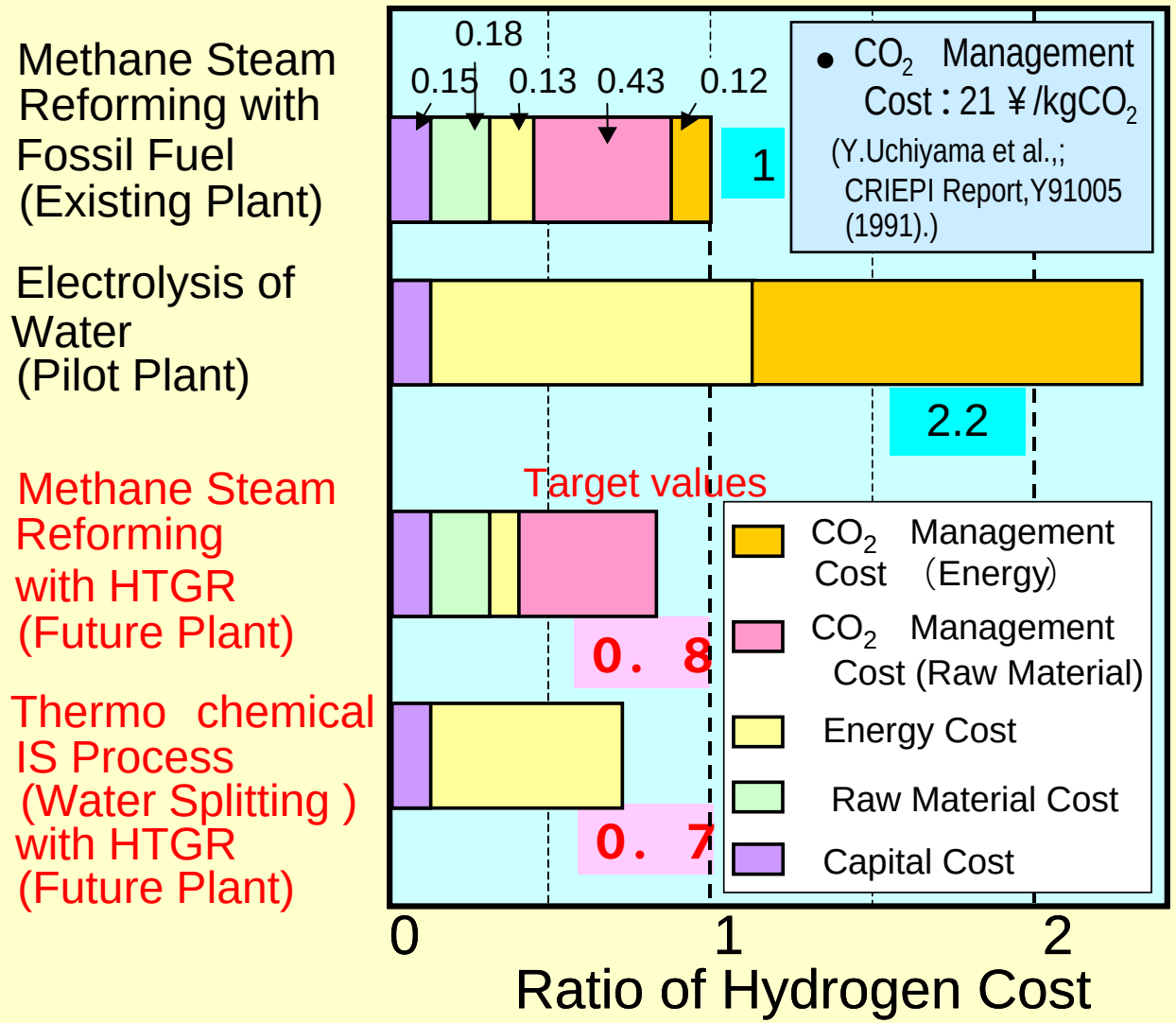


VHTR-GTH2 for Multipurpose Use

- HTGR Cascade Energy Plant for 80% efficient production of hydrogen, electricity and freshwater



Prospect of Cost Including CO_2 Management Cost



Future Plan of HTTR Project

2005 2010

Reactor technology (HTTR)
- Safety demonstration test
- Operation, Maintenance,
- High performance tests

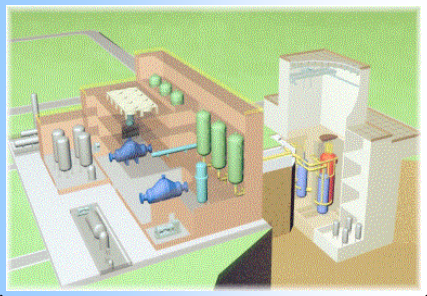
System Integration Technology
- Safety evaluation
- Isolation valve

Hydrogen Production Technology (IS Process)
- Pilot test (2005-)
- Component tests
- System analysis
- Verification of codes

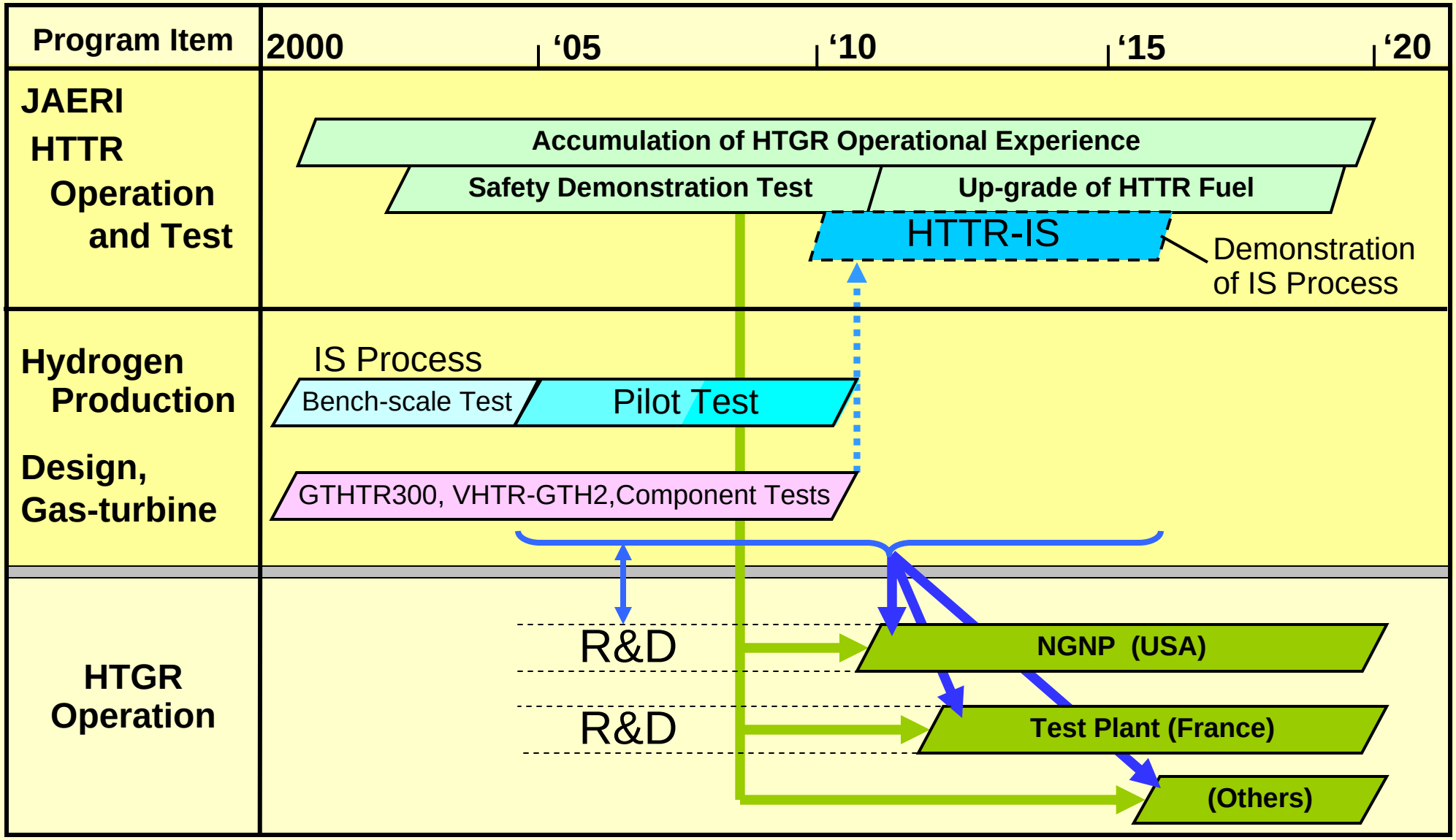
Hydrogen Production with HTTR-IS System

Commercial HTGR System

Hydrogen production for commercial use in 2020s



International Cooperation



Conclusion

- Nuclear production of hydrogen can meet massive demand in the future.
- HTGR is one of the most promising nuclear plants to produce hydrogen with high efficiency.
- The HTTR project at JAERI will facilitate the transition to a hydrogen economy.
- The R&D on hydrogen production with heat from HTGR shall be enhanced on a global base.